Evaluation of Dust Concentrations in an Iranian Portland Cement Industry

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ABSTRACT
Long term exposure to high levels of cement dust is one of the most important environmental risk factor in cement industries that adversely affect employees' respiratory system. Provided that achieving sustainable development mainly relies on healthy work forth, this study aimed at assessing cement dust concentration and its free SiO_2 content in an Iranian Portland Cement Industry.
In a cross sectional study, airborne dust levels was investigated by collecting 64 personal and 35 environmental samples at both inhalable and respirable dust sizes. Dust concentrations were determined by deploying personal samplers in the breathing zone of workers. SiO_2 fractions were also measured in 4 samples collected from different part of the factory.
Results: Arithmetic average concentrations of inhalable and respirable dust in personal sampling campaign were 58 and 13 mg m^{-3}, respectively. Respective values for inhalable and respirable dust in environmental sampling campaign were 154 and 27 mg m^{-3}. Dust concentrations in 90% of environmental samples and 80% of personal samples exceeded those occupational exposure limit values set for inert dusts i.e. Portland Cement. The average free SiO_2 fraction in analyzed samples was 2.86% varying from 2.33% in "packing and loading" area to 3.67% in "raw mill" section. Free SiO_2 fraction as well as the concentrations of cement dust in this study is much higher than those of occupational exposure limit proposed by Iranian Technical Committee of Occupational Health.

Keywords: *Portland Cement, Free Silica, Dust, Air Pollution, Ardabil*

I. INTRODUCTION

The first Iranian Cement industry was established in 1933 and about 92970 tone/year Portland cement was produced by 66 factories in 2000 [1]. Chemical composition of Portland cement varies depending upon their raw material used and mainly constitute of calcium silicate, chalk, crystalline silica, and MgO_2 and CaO_2 [2].

It has found variety of application especially as a concrete in buildings and a large number of worker are exposed to these materials during their production, storage, transport, and use which may cause skin, eyes, digestion system, and respiratory system disorders either in short or in long terms [3,4,5]. In terms of occupational health issues they are classified as inert dusts and it is generally believed that exposure to time weighted average of 10 mgm^{-3} of total and 5 mgm^{-3} of respirable dusts usually would not be accompanied with serious adverse health effects on human [6]. However they could be more harmful if other highly toxic compounds like free SiO_2, which are classified as a human carcinogen, are present in their composition.

Although inconsistence date set has been published regarding to adverse effect of occupational exposure to these kinds of pollutants [7,8,9], lack of advanced technology and effective control measures in developing countries make employees to expose to high concentrations of dusts in cement industries that may lead to serious health problems in long term. Given these information and lack of comprehensive data set in Iranian cement industries we tried to identify the load of dust pollution and the extent of workers exposure to those compounds.

II. MATERIAL AND METHOD

Occupational inhalation exposure among workers in an Iranian cement industry was investigated by collecting 64 personal and 34 environmental samples in total and respirable dust scales from 2001 to 2002. SiO_2 fractions were